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ABSTRACT

An econometric model was developed for use in measuring the impact of the Louisiana State University (LSU) upon the Louisiana economy. Emphasis is placed on measuring the effects of enrollment changes, salary and wage expenditures, and campus construction activity. The results show that, overall, each dollar spent by the LSU System creates another $.72 of income within the state economy. The model can be applied to any other institution and can be recalibrated at various points in time. It is also useful in demonstrating the importance of institutions to state legislatures and the general public. Areas where improvements could be made in the LSU impact model are noted. (Author/SW)

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THE ECONOMIC IMPACT OF THE LOUISIANA STATE UNIVERSITY SYSTEM ON THE LOUISIANA ECONOMY

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Mary Corcoran
University of Minnesota
(Editor, AIR Forum Publications)

ABSTRACT

In this study an econometric model is developed for use in measuring the impact of the Louisiana State University (LSU) System upon the Louisiana economy. Emphasis is placed on measuring the effects of enrollment changes, salary and wage expenditures, and campus construction activity. The results show that, overall, each dollar spent by the LSU System creates another $.72 of income within the state economy. The model can be applied to any other institution and can be recalibrated at various points in time. It is also useful in demonstrating the importance of institutions to state legislatures and the general public.

Section I

INTRODUCTION

The Louisiana State University (LSU) System is a major provider of employment and income in Louisiana. In the fall of 1979, 49,661 students were attending classes at LSU campuses. During the 1978-79 fiscal year (July 1-June 30) the University spent $309 million in operating expenditures. Approximately 14,000 persons were employed within the LSU System during that same year, and $197 million were expended on salaries and wages. In addition to the regular budgeted expenditures, another $50 million went toward the construction and renovation of physical facilities at LSU's campuses.

Problem Statement

The purpose of this study is to determine the impact that the LSU System has upon the state economy. Emphasis is placed on measuring the effects of enrollment changes, salary and wage expenditures, and plant investment activity.

Review of Existing Studies

Typically, university impact studies are conducted using economic base models. A short survey of these studies is found in an article by Salley (1978). The college is considered to be a basic or export sector of the local economy. Educational services are a unique export in that they are consumed locally.

Using the approach suggested by Tiebout (1962), the effects of faculty, student, and direct university spending upon non-basic or local activity can be determined. These studies contain the usual drawbacks of economic base studies. First, those researchers who rely on indirect measurement of the economic base must decide how to allocate economic activity between local and non-local sectors. Whether location quotients or minimum requirements techniques are employed, the decision is somewhat arbitrary. With regard to education, a

debate exists as to what portion of university spending and/or employment should be classified as basic. Cook (1970) points out that if local educational expenditures would be spend elsewhere in the absence of a university, then perhaps all local university spending should be classified as basic. Further, when aggregate multipliers are derived from the entire export sector of the economy, a differential impact for the university segment of the sector is not allowed. More disaggregate models often rely upon more direct measurement techniques such as surveys of local student and faculty spending. These techniques are more expensive and suffer reliability problems when completed.

A second methodology which can be used for measuring regional economic impact is Leontief's (1936) input-output analysis. Input-output tables can be constructed by taking a survey of transactions in local industries. The cost of using this approach is high and becomes even more prohibitive as detailed sectors are added. A less expensive alternative is to construct a transactions table which uses coefficients derived from other input-output studies (usually national). Using an input-output table constructed from national coefficients, multipliers were derived for industries in Louisiana by Hargrave and Burford (1973). One of these sectors was educational services. A multiplier of 1.52 was calculated for this sector, meaning that a $1.00 increase in final demand for education results in an increase of $1.52 worth of output for the Louisiana economy.

A third technique for the analysis of local economic impact is the use of an econometric model. Fishkind, Milliman, and Ellson (1978) use an econometric model to analyze the impact of an enrollment cap at the University of Florida. Since the university is the primary export industry in the Gainesville economy, significant restraining effects upon employment, income, and population are discovered.

Econometric models can be estimated at relatively low cost. Secondary data can be used and multipliers can be calculated for specific sectors of the local economy. Short-run (static) and long-run (dynamic) multipliers can be calculated, and the impact of future events can be determined through alternative model simulations.

Section II

METHODOLOGY

Regression Analysis

A regression model is developed for analysis of the impact of the LSU System. The basic equations of the model are presented in Table 2.1, while the variable definitions appear in Table 2.2.

TABLE 2.1. LSU IMPACT MODEL EQUATIONS

(1) ELSU = a1 + a2*ENLSU + a3*TAX + a4*SLGELA

(2) WLSU = b1 + b2*ELSU + b3*P + b4*T

(3) EOTH = c1 + c2*EUS + c3*ELSU

(4) WOTH = d1 + d2*EOTH + d3*WROTH + d4*T

(5) ECONLA = e1 + e2*VLSU + e3*VLA + e4*ECONUS
+ e5*RESLA + e6*NONRESLA + e7*T

(6) EOTH1 + f1 + f2*EUS1 + f3*ECONLA + f4*T

(7) WOTH1 = g1 + g2*EOTH1 + g3*WROTH1

TABLE 2.2 DEFINITION OF VARIABLES IN LSU IMPACT MODEL

Variable name	Definition
ELSU	Employment, LSU System
ENLSU	Enrollment, LSU System
TAX	General State Tax Revenues, Louisiana
SLGELA	State and local government employment, Louisiana
WLSU	Salaries and wages, LSU System
P	Gross National Product Implicit Price Deflector, U.S.
T	Time
EOTH	Employment in Louisiana (ELA) minus LSU System Employment (ELSU)
EUS	Total Employment, U.S.
WOTH	Salary and wage income in Louisiana (WLA) minus LSU System salary and wage income (WLSU)
WROTH	WOTH divided by EOTH
ECONLA	Construction Employment, Louisiana
VLSU	Plant investment, LSU System
VLA	Value of new construction projects, Louisiana
ECONUS	Construction employment, U.S.
RESLA	Number of new residential construction contracts, Louisiana
NONRESLA	Number of new non-residential construction contracts, Louisiana
EOTH1	Employment in Louisiana (ELA) minus construction employment in Louisiana (ECONLA)
EUS1	Employment in U.S. minus construction employment in U.S.
WOTH1	Salary and wage income in Louisiana (WLA) minus construction salary and wage income in Louisiana (WCONLA)
WROTH1	WOTH1 divided by EOTH1

The demand for educational services at the University is expressed in two ways in the model. First, additional students are hypothesized tc lead to greater employment and income within the LSU System. Second, a portion of new state tax revenues will end up in the hands of the university, leading to increased employment and income. Thus, in equation (1) employment in the LSU System is expressed as a function of enrollment and state general tax revenues. In addition, state and local government employment in the State of Louisiana is included as a long-run trend variable. Equation (2) views university salary and wage income as being determined by the level of employment and the price level. Total salary and wage expenditures are thus seen to arise from employment increases and as a result of inflation. The variable time is included as a long-run trend factor.

Equations (3) and (4) explain the impact of employment changes at LSU upon employment and income in all other sectors of the Louisiana economy. Their spending creates employment and income opportunities for others. Thus, changes in university employment and salaries lead to multiple employment and income creation in the state. Equation (3) posits employment outside the LSU System to be a function of employment at LSU and total U.S. employment. The latter variable is selected because it is believed to explain the majority of changes in Louisiana employment, thus leaving some of the unexplained changes to be determined by the LSU System. In equation (4) salary and wage income in other sectors of the Louisiana economy is determined by employment and wage rates in those sectors. Time is also included as a long-run trend variable.

The basic workings of the first four equations of the model are illustrated with the aid of the block diagram in Figure 2.1. In this diagram, the effect of an enrollment increase is viewed as an increase in demand for university services. This leads, first, to an increase in employment at the university. The change in LSU employment, in turn, leads to the creation of other jobs in the community. Thus, the overall level of employment in Louisiana is expected to rise. The employment changes lead to increases in salary and wage payments both at LSU and in the remaining sectors of the state economy. Thus, the level of state personal income is raised as a result of the enrollment increase.

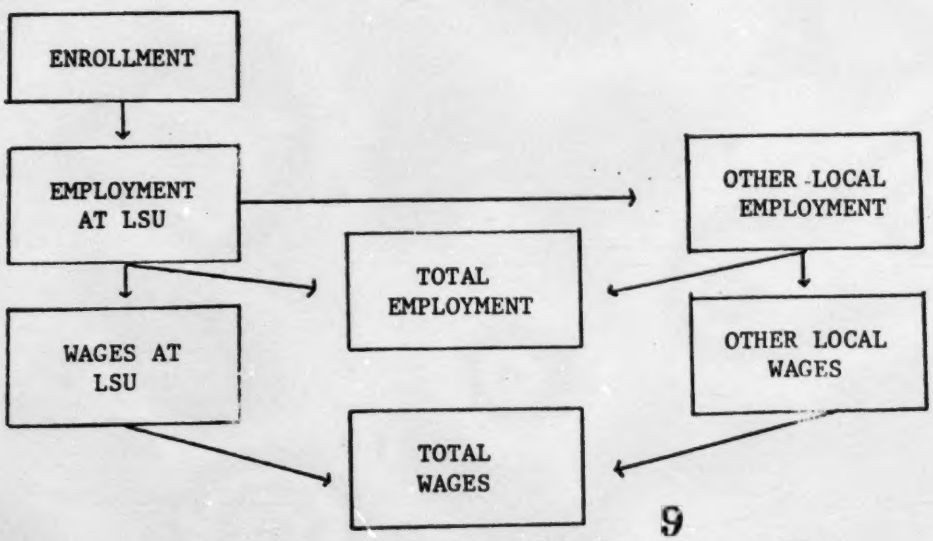

FIGURE 2.1 - BLOCK DIAGRAM OF LSU IMPACT MODEL

The construction sector of the LSU Impact Model begins in equation (5). This equation is used to determine the impact of capital expenditures within the LSU System upon employment in Louisiana's construction industry. Other variables included to explain construction employment are the value of all residential and nonresidential projects started in Louisiana, U.S. employment in the construction industry, the number of residential construction projects started in Louisiana, and the number of nonresidential construction projects started in Louisiana. Time is also included as a long-run trend variable.

Equation (6) relates employment in Louisiana's construction industry to other employment in the state. Employment in non-construction industries in the U.S. is also included as an explanatory variable. Again, time is included as a variable. The last equation relates non-construction employment changes to salaries and wages in these industries. The (non-construction) wage rate is also included to allow for inflationary salary and wage increase.

Figure 2.2 contains a block diagram which illustrates the operation of the construction sector. Capital expenditures at LSU campuses generate employment in the state construction industry. This employment gain is multiplied as construction industry employees spend their incomes locally. The income created indirectly is combined with initial capital spending to form the total dollar impact of LSU investment activity.

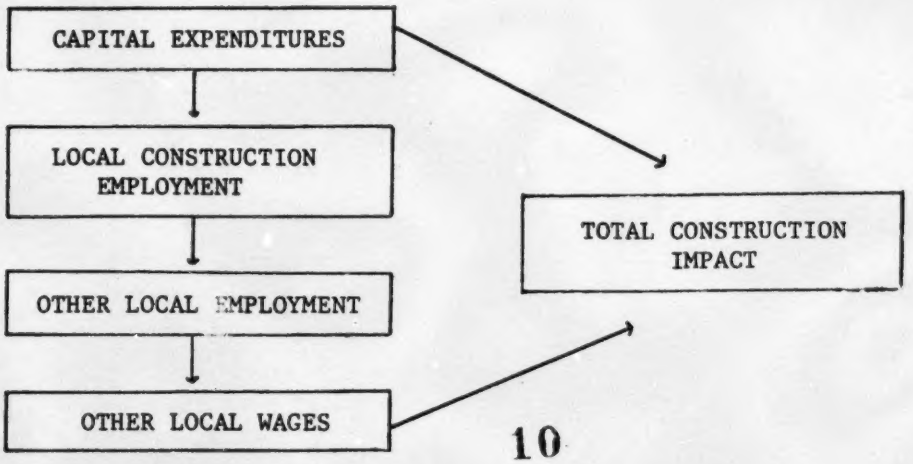

FIGURE 2.2 - BLOCK DIAGRAM OF CONSTRUCTION SECTOR, LSU IMPACT MODEL

The LSU Impact Model is recursive and can be solved sequentially. The equations are estimated using Ordinary Least Squares (OLS) regression. Use of OLS for a recursive system generally results in consistent parameter estimates.

Impact Analysis

Once the regression equations are estimated, multipliers are derived for impact analysis. First, each coefficient is interpreted to be a multiplier. For example, the coefficient called a2 in equation (1) is interpreted as the change in LSU employment which results from a unit change in enrollment. Similarly, the coefficient a3 is interpreted as the change in LSU employment which occurs as a result of a unit change in state general tax revenues.

There is also a set of multipliers which is derived indirectly from the model coefficients. These are the multipliers of primary interest in this study. The first multiplier is the change in LSU salary and wage income which results from a change in enrollment within the LSU System. It is derived as follows:

(1) $$\frac{\Delta \text{ WLSU}}{\Delta \text{ ENSLU}} = \frac{\Delta \text{ ELSU}}{\Delta \text{ ENLSU}} * \frac{\Delta \text{ WLSU}}{\Delta \text{ ELSU}} = a2*b2$$

Next, the effect of an enrollment change upon salary and wage income in other sectors of the Louisiana economy can be determined:

(2) $$\frac{\Delta \text{ WOTH}}{\Delta \text{ ENSLU}} = \frac{\Delta \text{ ELSU}}{\Delta \text{ ENSLU}} * \frac{\Delta \text{ EOTH}}{\Delta \text{ ELSU}} * \frac{\Delta \text{ WOTH}}{\Delta \text{ EOTH}} = a2*c3*d2$$

Third, the study is concerned with measuring the impact of salary and wage changes of the university upon salaries and wages outside the university sector. This effect is calculated as follows:

(3) $$\frac{\Delta \text{ WOTH}}{\Delta \text{ WLSU}} = \frac{\Delta \text{ ELSU}}{\Delta \text{ WLSU}} * \frac{\Delta \text{ EOTH}}{\Delta \text{ ELSU}} * \frac{\Delta \text{ WOTH}}{\Delta \text{ EOTH}} = \frac{1}{b2} * c2*d2$$

Finally, the effect of new capital expenditures within the LSU System upon salaries and wages in the Louisiana economy is determined:

(4) $$\frac{\Delta \text{ WOTH1}}{\Delta \text{ ULSU}} = \frac{\Delta \text{ ECONLA}}{\Delta \text{ ULSU}} * \frac{\Delta \text{ EOTH1}}{\Delta \text{ ECONLA}} * \frac{\Delta \text{ WOTH1}}{\Delta \text{ EOTH1}} = e2*f3*g2$$

Sources of Data

Educational data were collected by the Office of Institutional Research, Louisiana State University System. Time series data pertaining to enrollment, capital expenditures, salaries and wages, and employment were provided. Historical data begin in fiscal year 1968-69 and end in fiscal year 1978-79. The historical series are utilized in the regression analysis and in measuring past and present university system impact. In addition, the Office of Institutional Research developed projections of enrollment and capital spending for each LSU campus. These projections are used in measuring the future economic impact of the LSU System.

Louisiana aggregate income data were derived from printouts provided by the Bureau of Economic Analysis, U.S. Department of Commerce. State employment data were obtained from various monthly and annual reports and releases of the Division of Employment Security, Louisiana Department of Labor. Price level data were taken from the Gross National Product (GNP) accounts published in the Survey of Current Business, U.S. Department of Commerce. State tax revenue data were obtained from the State of Louisiana, Financial Statement, Division of Administration. Construction data were obtained from F.W. Dodge Division, McGraw-Hill Information Systems Company.

Section III

RESULTS

Regression Analysis

The Louisiana Impact Model results are presented in Table 3.1. The major results are highlighted below.

The coefficient on enrollment in equation (1) indicates that, everything else held constant, an increase of 1,000 students implies 143 new jobs within the University System. This result must be interpreted cautiously, since the coefficient is not statistically significant. State tax revenues, on the other

hand are a significant determinant of systemwide employment. The coefficient estimate implies that a $1 billion increase in general state revenues (ceteris parabus) results in 400 LSU jobs.

In equation (2), the coefficient on LSU employment indicates that each additional employee generates $8,706 in LSU salaries and wages, with the price level held constant. The employment variable is highly significant. Equation (3) implies that an additional LSU employee generates 1.2 jobs in other sectors of the state economy. This coefficient, however, does not meet tests of statistical significance. Each of the outside jobs created by the LSU System generates $4,786, all other factors held constant. This result appears in equation (4).

Equations (5), (6), and (7) make up the construction sector of the Louisiana model. A $1 million increase in physical plant construction at LSU implies 200 additional jobs in Louisiana's construction industry, according to equation (5). The plant investment coefficient, however, was not statistically significant. Equation (6) demonstrates that an additional job in Louisiana's construction sector creates an additional 1.2 positions in other sectors of the state economy. Each of these additional employment opportunities generates $2,927, everything else held constant. This result is contained in equation (7) of the model.

TABLE 3.1 REGRESSION RESULTS: LOUISIANA MODEL

1. ELSU = 15.005 + .143 ENLSU + .004TAX − .094SLGELA
   (3.1) (.9) (5.0) (−2.0) R^2 = .956
2. WLSU = −171.036 + 8.706 ELSU + 1.943P − 6.527T
   (−7.0) (4.9) (5.5) (−2.7) R^2 = .996
3. EOTH = −744.992 + .025 EUS + 1.232 ELSU
   (−2.2) (3.8) (.1) R^2 = .965
4. WOTH = −11673.8 + 4.786EOTH + 1946.7 WROTH − 40.085 T
   (−1.4) (.5) (9.4) (−.1) R^2 = .998
5. ECONLA = 50.754 + .0002 VLSU + .000006 VLA + .006 ECONUS
   (5.8) (1.2) (2.9) (2.6)
   −.209 RESLA − 9.646 NONRESLA + 4.021T
   (−3.1) (−1.6) (5.1) R^2 = .999
6. EOTH1 = 471.699 + .005 EUS1 + 1.187 ECONLA + 24.207T
   (2.3) (1.5) (1.6) (5.1) R^2 = .996
7. WOTH1 = −9401.09 + 2.927 EOTH1 = 1849.95 WROTH1
   (−7.2) (1.2) (12.7) R^2 = .999

Note: t-statistics in parentheses.

Impact Analysis

A selected group of multipliers that is derived from the Louisiana Impact Model appears in Table 3.2. These multipliers are calculated using the methodology described in Section II.

A change in demand for the services of the university is expressed through an enrollment change. The results indicate that each new student enrolled at an LSU campus results in an additional $1,240 in wages and salaries within the university system. This new university income, in turn, creates another $840 in salaries and wages in the state economy. Overall, then, each additional student produces $2,080 in wage and salary income to the Louisiana economy.

Each dollar increase in university salary and wage expenditures is estimated to lead to an additional $.68 in statewide salary and wage income. Altogether, $1.68 is added to the state economy.

Every dollar of plant investment expenditures leads to another $.88 in salary and wage income in the state economy. Altogether, $1.88 is contributed to the economy for every dollar of plant investment activity.

TABLE 3.2 IMPACT MULTIPLIERS

Multiplier	Value
$\frac{\Delta \text{ WLSU}}{\Delta \text{ ENLSU}}$	$1,240.00
$\frac{\Delta \text{ WOTH}}{\Delta \text{ ENLSU}}$	840.00
$\frac{\Delta \text{ WOTH}}{\Delta \text{ WLSU}}$	.68
$\frac{\Delta \text{ WOTH}}{\Delta \text{ VLSU}}$	.88

Using the impact multipliers, the combined value of salary, wage and plant investment, expenditures of the Louisiana economy can be estimated. First, direct LSU salary and wage expenditures are multiplied by .68 to determine the indirect or induced impact on salaries and wages outside the university sector. The total impact of university salary and wage expenditures on the state economy is then equal to the sum of direct and induced effects. The total impact can also be computed by multiplying direct LSU salary and wage income by 1.68.

Similarly, direct university plant investment spending is multiplied by .88 to determine the induced effect on income outside the university sector. The indirect impact on income is then added to initial LSU investment expenditures to obtain the total impact of LSU plant investment on the state economy. The total inpact can also be obtained by multiplying direct university investment times 1.88.

Using the procedure described above the value of the LSU System to the state economy during the 1978-79 fiscal year is measured in Table 3.3. During that year the university system expended $197 million in salaries and wages. According to the impact model, this induced an additional $133 million in income outside the university sector. Thus, a total of $330 million was created in wages and salaries. During the same fiscal year, the university system spent $50 million in plant investment which induced another $44 million in economic activity around the state. A total of $94 million thus resulted from construction activity at the various LSU campuses. Adding the construction impact to the salary and wage impact yields a total university system impact of $424 million. Dividing the total (direct plus indirect) impact by the value of direct salary, wage, and investment spending yields a total impact multiplier of 1.72 for the LSU System.

TABLE 3.3 VALUE OF LSU SYSTEM TO STATE ECONOMY
FISCAL YEAR 1978-79

	Direct Impact	Indirect Impact	Total Impact
Salary and Wage Expenditures	$196,850,837	$133,464,860	$330,315,697
Plant Investment	49,803,398	43,826,990	93,630,388
Total Expenditures	246,654,235	177,293,850	423,946,085

The above results must be qualified. Although they comprise the largest portion of the LSU System budget, salaries and wages are not the only budget item. Other items such as travel and supply and equipment purchases are also part of the overall budget. During the 1978-79 fiscal year, for example, other items accounted for another $113 million. As a percent of total expenditures, including plant investment, other items comprised 31 percent of the budget. Assuming, naively, that these other items have only a direct impact on the state economy (and hence a multiplier equal to 1), the total impact of the university system is $537 million in fiscal year 1978-79. If we were to assume that these items have a multiplier equal to 1.7, then the total impact of the LSU System would be $618 million.

It should be added that many university expenditures may be spent outside of the state. Materials for construction, for example, may be imported to the state. To the extent that this occurs, the multipliers derived in this study may be overstated.

Finally, the impact of future enrollment and plant investment changes are analyzed. Table 3.4 presents the projections of enrollment impact. Enrollment changes are derived from the enrollment projections of the LSU System Office of Institutional Research. Each annual enrollment is multiplied by the relevant multipliers from the Louisiana Impact Model to determine the effects on salaries and wages. For example, an increase of 2,425 students is forecast for the 1980-81 academic year. According to the regression results, this should add $3,007,000 to the salary and wage portion of the LSU System budget. Further,

$2,037,000 of salary and wage income should be directly created in the Louisiana economy. Overall, then, $5,044,000 should be added to the state economy as a result of the projected change in enrollment.

TABLE 3.4 IMPACT OF FUTURE ENROLLMENT CHANGES

Year	Enrollment Change From Previous Year	Impact on LSU Wages and Salaries	Impact of Other Wages and Salaries	Total Impact
1980-81	2,425	$3,007,000	$2,037,000	$5,044,000
1981-82	1,651	2,047,240	1,386,840	3,434,080
1982-83	956	1,185,440	803,040	1,988,480
1983-84	711	881,640	597,240	1,478,880
1984-85	286	354,640	240,240	594,880

The impact of future plant investment activity of LSU is put forth in Table 3.5. Multipliers derived from the construction sector of the Louisiana Impact Model are used to measure these effects. Capital expenditure forecasts are drawn from projections of the System Office of Institutional Research. During fiscal year 1979-80, about $84 million of capital expenditures are anticipated. According to the impact model, an additional $74 million in income will be created by this activity. The total impact of LSU plant investment expenditures will thus be equal to $158 million in that year.

TABLE 3.5 IMPACT OF PLANT INVESTMENT

Year	Plant Investment	Impact on Other Wages and Salaries	Total Impact
1979-80	$ 83,838,850	$ 73,778,188	$ 157,617,040
1980-81	77,500,000	68,200,000	145,700,000
Total Authorized Capital Expenditures	280,076,850	246,467,630	526,546,130

Strengths and Weaknesses of the Study

The multipliers derived in this study are in line with the results obtained in other educational impact studies. Salley (1978), using an economic base approach, derives a multiplier of 1.48 for Georgia State University spending. The Louisiana input-output study of Hargrave and Burford (1973) derives a

multiplier of 1.52 for educational services. This study, using an econometric approach, derives an overall multiplier of 1.72 for the LSU System.

Salley also presents a comparison of multipliers obtained from other university impact studies. A Wisconsin State University study derived multipliers ranging from 2.0 to 2.3. At the other extreme, a multiplier of 1.1 was calculated from Kent State University. Finally, a study of Eastern Kentucky University obtained a multiplier of 1.75. This last result is similar to the overall multiplier derived in this study.

The multipliers derived in this study may be somewhat overstated as a result of equation misspecification. That is, there are variables that could have been theoretically included in the model which may have reduced the size of the coefficients already included in the model. For practical reasons, these variables could not be introduced into the model. Since the multipliers are derived from the model coefficients, there is reason to believe that they too are biased upward.

It is believed that improvements could be made in the construction sector of the LSU Impact Model. For example, some of the capital spending at the university is paid to out-of-state contractors. No allowance is made for this in the model.

One of the major advantages of the approach taken in this study is the ability to simulate alternative events within the university system. Effects of enrollment changes, tax revenue changes, wage increases or decreases, and new construction projects are examples of the kinds of occurrences which may be investigated with this technique. Projections may also be utilized to obtain the impact of expected future changes.

Further Research in Progress

The econometric model developed for the LSU System can be applied, with some adjustment, to individual campuses of the system. These models will be

used to determine the impact that activities at each campus have upon their respective local economies. Similarly, the model can be applied to other universities around the country.

Research is also underway concerning the impact of categories of university spending other than salaries, wages, and capital expenditures. In addition, further refinements in the modeling of university capital expenditures are being made.

Since a large portion of the LSU budget is derived from state government appropriations, an investigation of the return which the state gets for its money would be appropriate. The state, in turn, derives new tax revenues from this expanded tax base. An analysis of the size of this return would be a logical extension of the study.

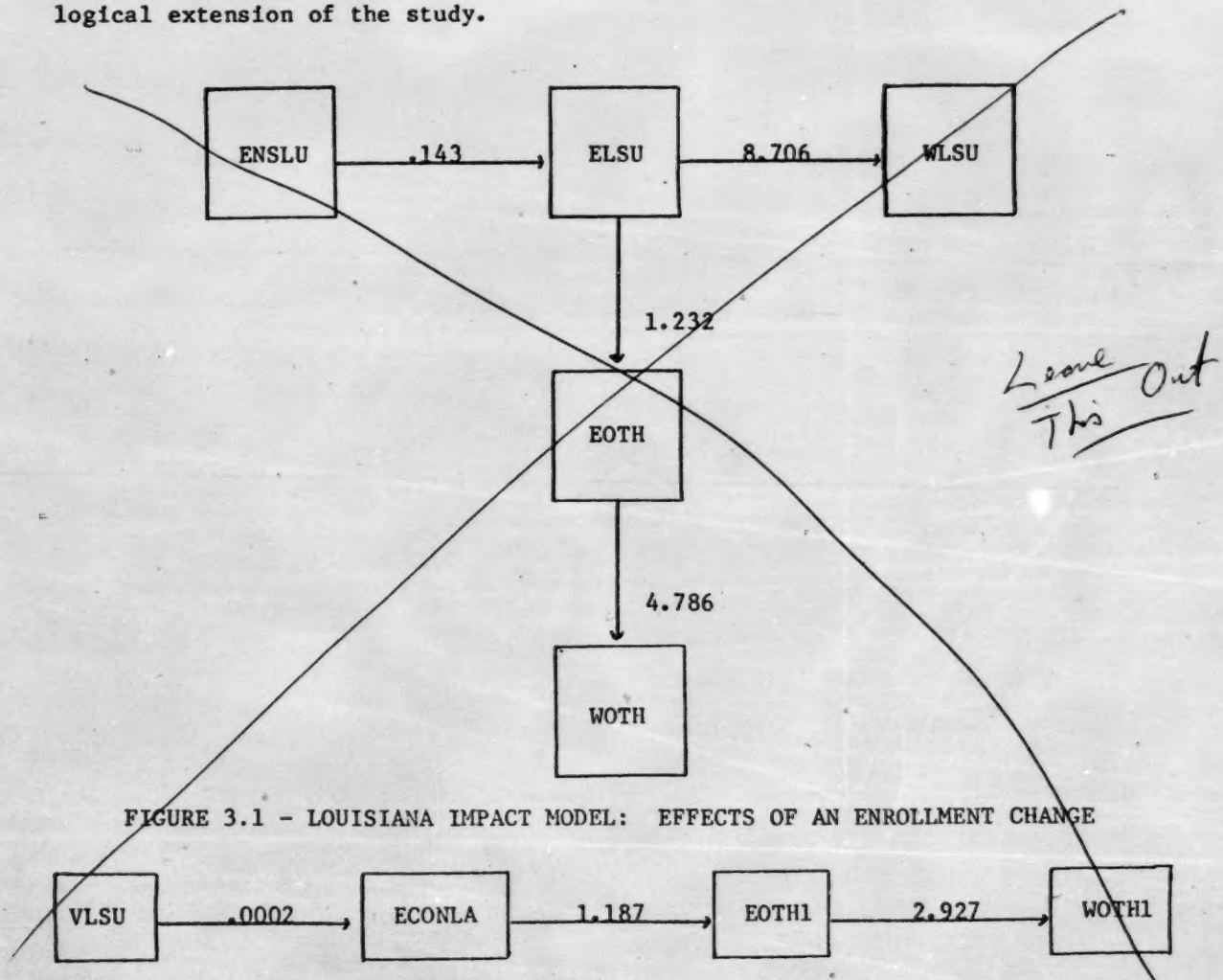

FIGURE 3.1 - LOUISIANA IMPACT MODEL: EFFECTS OF AN ENROLLMENT CHANGE

FIGURE 3.2 - EFFECTS OF CAPITAL EXPENDITURES

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